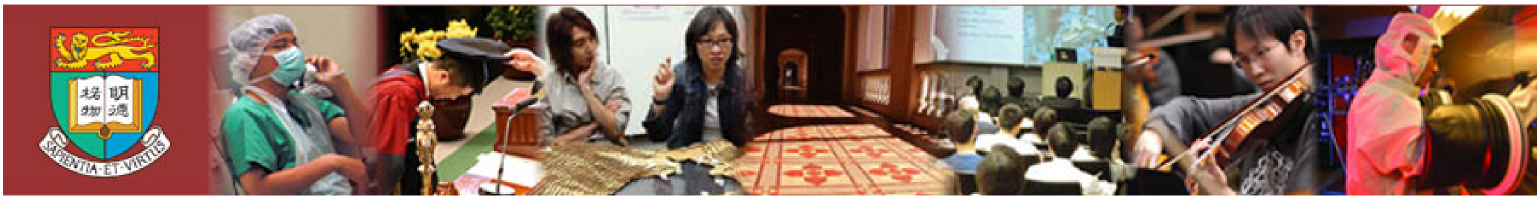

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A Cross-Linguistic Study of the Development of the Perception of Lexical Tones and Phones

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Abstract

The study investigated the development of the perception of lexical tones and phones in Cantonese-speaking children and adults. Stimuli from Thai (the official language of Thailand) were used in the study. Forty-eight children from kindergarten to primary six, and twelve adults were tested individually. The experiment required the listeners to choose the "odd-one-out" of three syllables in phone awareness and tone awareness tasks. The results suggested that children and adults generally performed better in phone awareness tasks than tone awareness tasks although tones are important in defining word meaning in Cantonese. Improvement was observed for both tasks across ages; greater improvement was observed in phone awareness tasks. Better performance was found for adults with higher education level than those with lower education level in both tasks. The finding shows that education level plays a role in phone and tone awareness. Similarities and differences with the performance of Thai and English listeners will be discussed.

Introduction

Phonological awareness is related to the understanding of the underlying phonological structure of the oral language. It involves the understanding that words are composed of, smaller components, such as syllables, onsets (initial consonant or consonant cluster of a syllable), rhymes (vowels or the succeeding consonant/ consonants), phonemes and tones (in tone languages) (Chard & Dickson, 1999). This knowledge can be measured through the manipulation of phoneme deletion or addition (e.g. add or delete the initial or final segment of a syllable), in odd-one-out tasks (e.g. choose the one differs from the other two choices), or in phoneme substitution (e.g. substitute /c/ into /m/ in the word /can/).

Several studies tried to investigate the development of phonological awareness in children. Some researchers suggested that young children at 5;08 are not able to analyze the spoken utterances into phonemes before they started to read (Liberman, Shankweiler, Fischer & Carter, 1974). However, other studies argued that preschoolers do have the ability to divide the words into sub-syllabic components of onset and rhyme rather than to identify one of the consonants of the cluster or a single phoneme between the vowel and the following consonant (Treiman, 1985). After children learn to read an alphabetic script, it is easier for them to identify the single phoneme in words (Mann, 1986). From these studies, it seems that there is a strong relationship between the development of phonological awareness and reading; that is, phonological awareness develops after children start to read. However, phonological awareness is not a all-or-none ability that depends on reading. Bryant and Bradley (1985) suggested that there are different levels of phonological awareness. Children may have some levels of phonological awareness before learning to read alphabet script; some other levels may appear after they learn to read the alphabetic orthography. This idea is supported by studies on the development of phonological skills. For example, Bradley and Bryant (1983) found that English-speaking children are able to detect syllables, onsets and rhymes at four years old. However, they are unable to detect phonemes when they began to read at the age of five or six (Liberman et al, 1974).

While the studies mentioned above investigated the development of phonological awareness of children learning alphabetic languages, the development of phonological awareness may be different for children learning to read a nonalphabetic language (such as Chinese). Moreover, Chinese languages such as Cantonese are tone languages, in which tone also play an important role in determining the word meanings besides the consonants and vowels. Therefore, tone is likely to be one of the aspects involved in the development of phonological awareness in Cantonese children. Ho and Bryant (1997a) conducted a longitudinal study of the phonological awareness of Cantonese children. They found that Cantonese children were able to detect rhyme and tone together (e.g. /tai1/, /gai1/ or /mong5/, in which the odd item /mong5/ is differed from the similar items in both rhyme and tone), even as young as three years old. Children at the age of 5;08 had a significant better performance in rhyme alone detection than tone alone detection. The study also showed that, although children in seven years old were able to detect onset, rhyme and tone alone, better performance was shown in rhyme detection rather than in onset or in tone alone detection (however, this difference was not significant). It seems that children perceive phones (indicate the fundamental units of speech which are perceptibly different) better than tones in their development of phonological awareness, in spite of the fact that the acquisition of lexical tones in Cantonese speaking children has been found to occur earlier than that of the consonants and vowels.

Tone acquisition in Cantonese Children

So and Dodd (1995) found that four children aged 1;02 to 2;00 acquired all the nine lexical tones (six contrastive and three stopped tones) in Cantonese by the age of two. This finding supported earlier claims from another longitudinal study of a Cantonese-speaking baby boy, in which the boy could acquire all the nine lexical tones by the age of 1;09 (Tse, 1977). Children in these two studies showed a similar pattern in the acquisition of tones. They all acquired one or two of the level tones (i.e.

high and mid level) first, followed by the high-rising tone and the three stopped tones. The low-falling, low-rising and the low-level tones were usually among the latest to be acquired. However, a longitudinal study of a boy acquiring Cantonese between the ages of 1;03 to 3;00 showed that tone acquisition was not complete by the age of two (Tse, 1991). The contrast between the three low-pitched tones (i.e. low-falling, low-rising and low level) was not completely established at age three for the child by the end of the study.

Although children acquire all the lexical tones in Cantonese at an early age, it is likely that some tones are easier to identify than other tones, since some tones have similar auditory patterns (e.g. low-rising and high-rising tones). Ching (1984) carried out a study in order to determine the development of the perception of lexical tones in Cantonese. She used both natural and synthetic tone stimuli to assess children's ability in perceiving the acoustic pattern differences. She found that tone recognition ability improved with age and that children above six years old showed more accuracy in recognizing the natural speech stimuli than younger children. Although they started to recognize the synthetic speech stimuli in the study at age six, their recognition ability still did not approach the performance of adults. The result showed that only at ten years of age children had comparable performance in recognizing both natural and synthetic speech stimuli with that of adults.

The present study is a part of the research carried out in Thailand and Australia by Dennis Burnham and his colleagues at the University of Western Sydney, Australia, and at Chulalongkorn University, Bangkok, Thailand. They used Thai stimuli in order to compare the ability in phonological and tone awareness tasks between Thai and Australian listeners, and the development of these abilities across different ages and education levels.

Comparison of Cantonese and Thai tonal system

Both Thai (the national language of Thailand) and Cantonese (the Chinese language spoken in Hong Kong) are tone languages in which pitch patterns are important for the lexical contrast of words, in addition to consonants and vowels. These pitch patterns, which are distinctive in word contrast, characterize lexical tones (Bauer & Benedict, 1997).

The number and type of lexical tones differ in Cantonese and Thai. In Cantonese, there are six contrastive tones: Tone 1 is described as "high-level" (55), Tone 2 as "high-rising" (25), Tone 3 as "mid-level" (33), Tone 4 as "low-falling" (21), Tone 5 as "low-rising" (23) and Tone 6 as "low-level" (22) (Bauer & Benedict, 1997). In Thai, there are five contrastive tones. Three of them are level tones (i.e. "high", "mid" and "low") and are analogous to the Cantonese level tones. The other two are contour tones, the "high-falling" and the "low-rising" tones.

Aim of study

The present study aims to investigate the ability of Cantonese children and adults in both phonological awareness and tone awareness tasks, when perceiving non-native Thai speech stimuli. The effect of age and education level of adults is considered as the factors that affect the performance. Based on the results of past research on the development of phonological awareness, the following predictions were formulated. Firstly, according to Ho and Bryant (1997a), Cantonese children at age three were able to detect both rhyme and tone changes (e.g. /tai1/, /gai1/ or /mong5/). The children heard the target syllable (e.g. /tai1/) and they were asked to choose whether /gai1/ or /mong5/ sounded similar to the target word /tai1/. And the performance improved as age increases. Although children at age seven were able to detect tone alone and onset alone, the detection of rhyme alone was still easier (Ho & Bryant, 1997a). Therefore, children in this study should have a better performance in the phone awareness than in the tone awareness tasks, and the performance in these tasks should improve as a function of age. Secondly, studies of phonological awareness of phones in illiterate Portuguese adults (Morais, Cary, Alegria & Bertelson, 1979, 1986) revealed that learning to read in the alphabetic system is required for developing the phone awareness of speech, but syllable segmentation and onset or rhyme detection could develop even without learning to read. Literate Chinese adults who had learned pinyin had a better performance in phoneme addition or deletion tasks than those who were literate only in reading Chinese characters without the pinyin system (Read, Zhang, Nie & Ding, 1986). These findings show that the development of phonemic segmentation (i.e. recognition of phonemes) requires the experience in alphabetic literacy. Therefore, tertiary-educated adults who are highly educated in alphabetic reading in English would have a better performance than that of primary-educated adults in phone awareness tasks. Finally, as Thai stimuli were used in the study, Thai listeners should have a better performance in perceiving their native language in both phone awareness and tone awareness tasks. Evidence from a study of cross-linguistic tone discrimination in Cantonese and Mandarin showed that Cantonese and Mandarin subjects did better in discriminating tones in their native language (Lee, Vakoch & Wurm, 1996).

Method

Participants

A total of sixty native Cantonese-speaking listeners with no known speech and hearing problem participated in this experiment. Twelve children (six boys and six girls) were recruited in each of the following groups: kindergarten (mean age = 4.9, age range = 4;06-5;06), Primary One to Two (mean age = 7.2, age range = 6;09-7;07), Primary Three to Four (mean age = 9.2, age range = 8;09-9;07), and Primary Six (mean age = 12.0, age range = 11;09-12;02). All the children were randomly recruited from one kindergarten and one primary school in the New Territories in Hong Kong. Two groups of adults were also recruited: a Primary-educated group (three males and three females, mean age = 41.5, age range = 25-53), whose final year of school ranged from Primary Five to Secondary Three, and a Tertiary-educated group (three males and three females, mean age = 22.7, age range = 22-24) whose tertiary education level ranged from second year in University to fresh graduation.

Stimuli

There were seven blocks of the Toneme-Phoneme task (also called "Odd-One-Out" task). The stimuli used were the same as those used by Burnham, Davis, Kim, Issa, Tam, Kasisopa, Tantong, Schoknecht, Jones & Luksaneeyanawin (2003). All the stimuli were recorded in Thailand by a female native Thai speaker using the Cool Edit Pro, a software on a PC computer. The speaker is a trained linguist at Chulalongkorn University, in Bangkok, Thailand.

There were eight trials in each block of the task. Two practice trials were added at the beginning of each block. Each trial contained three one-syllable Thai words. There were three sets of blocks: Tone and Vowel (TV), Phone only (Phone) and Tone only (Tone). Block TV contained items in which the odd-one-out stimuli differed from the other two in the tone and in the initial consonant and the vowel, e.g. /sɔːn4/,

/hɔːn4/, /baːn0/ (numbers refer to Thai tones, 0-mid; 1-low; 2-falling; 3-high; 4-rising; the underlined item was the odd-one-out). There were three Phone tasks in which the vowel was the basis of the difference in the odd-one-out. In Phone 1 task, the odd-one-out differed from the other two words in vowel and final consonant, while the initial consonant remained the same (e.g. /buam0/, /buaŋ0/, /beːn0/). In Phone 2 task, the odd-one-out differed from the other two words in vowel and the initial consonant, while the final consonant remained the same (e.g. /laːŋ3/, /naːŋ3/, /rɔːŋ3/). In Phone 3 task, the odd-one-out differed from the other two words in vowel, initial and final consonant (e.g. /rɔːŋ0/, /tɕʰɔːn0/, /lɑːm0/). The three Tone tasks, the tone was the basis of the different in the odd-one-out. In Tone 1 task, the odd-one-out differed from the other two words in tone and vowel, while the initial and final consonant remained the same (e.g. /juan0/, /jaːn0/, /jɔːn3/). In Tone 2 task, the odd-one-out differed from the other two words in tone and initial consonant, while the rhyme remained the same (e.g. /pʰak3/, /sak3/, /kak1/). In Tone 3 task, the odd-one-out differed from the other two words in tone, initial consonant and vowel, while the final consonant remained the same (e.g. /tɔːn2/, /saːn2/, /jɔːn0/). The odd-one-out could appear in any serial position among the three words. The stimuli were presented to the subjects through ATH-T2 Audio-Technica headphones at a comfortable level. One pair of headphones was connected to each of two notebook-computers; a Toshiba Satellite 2510 CDS (Pentium I) and a Dell Latitude CPi (Pentium II).

Procedure

The experiment was carried out in an IAC single-walled sound booth for the two adult groups. All the children were tested in a quite room in the kindergarten or primary school. Before running the experiment, all the subjects passed hearing screening at 250, 500, 1000, 2000 and 4000Hz, using a Micromate 304 Screening Audiometer. As in the kindergarten and in the school the background noise level was relatively high (i.e. the average background noise was 56dBA, measured by Quest Technologies 210 sound level meter) during the test, the hearing level for screening was adjusted to 30dBHL. All primary school subjects were administered the Chinese word reading sub-test of the Hong Kong Test of Specific Learning Difficulties in Reading and Writing (Ho, Chan & E.D., HKSAR Government, 2000) after they passed the hearing screening. This test was used to assess the children's reading ability. Then all the subjects were asked to identify the odd-one-out from the task after they heard the same three words twice. Two children had the task administered at the same time with these two computers. The DMDX program developed by Professor K. I. Forster and J.C. Forster at the University of Arizona was used for experimental presentation of visual and auditory stimuli for the experiment. Before listening to the stimuli, each subject was given the instruction verbally by the experimenter. They were asked to choose the odd-out-one after listening to each of the stimuli, the sequence of three words was repeated twice. Listeners were asked to answer by saying "1", "2" or "3". Half of the subjects in each group listened to the tasks in the order of TV, Phone1, Phone2, Phone3, Tone1, Tone2, Tone3; and the other half in the order of TV, Tone1, Tone2, Tone3, Phone1, Phone2, Phone3. Two practice trials were given to the subjects before listening to the experimental trials in each task. For each of the practice trials, if the subjects gave the wrong response, the experimenter would verbally repeat the three stimuli and tell the subject which one was the odd-one-out. No feedback was provided after the subjects' response during the experimental trials. After listening to the forth task (i.e. either Phone3 or Tone3), subjects were again verbally instructed by the experimenter. They were told not to use the same rule as used in the previous tasks in choosing the odd-out-out in the rest of the task.

Result

A two-way analysis of variance (ANOVA) of Age Group (Kindergarten, Primary 2, Primary 4, Primary 6, Tertiary-educated adult and Primary-educated adult) x Task (TV, Phone 1, Phone 2, Phone 3, Tone 1, Tone 2 and Tone 3), i.e. 6 x 7, with repeated measures on the task factor was carried out. As the difference between the smallest and the largest variance was larger than ratio 1:4, the arcsine transformation was used in order to correct the violation of the assumption of homogeneity of variance (Howell, 1997). Post-hoc Tukey's Standardized Range (HSD) Tests were administered in order to carry out comparisons among conditions (Howell, 1997). The main effects of age and task were highly significant (F (5, 54) = 9.91, p<0.000; F (6, 324) = 44.14, p<0.000 respectively); the interaction effect between age and task was also statistically significant (F (30, 324) = 2.35, P< .0001).

Figure 1 shows that the performance across all tasks improved as age increased.

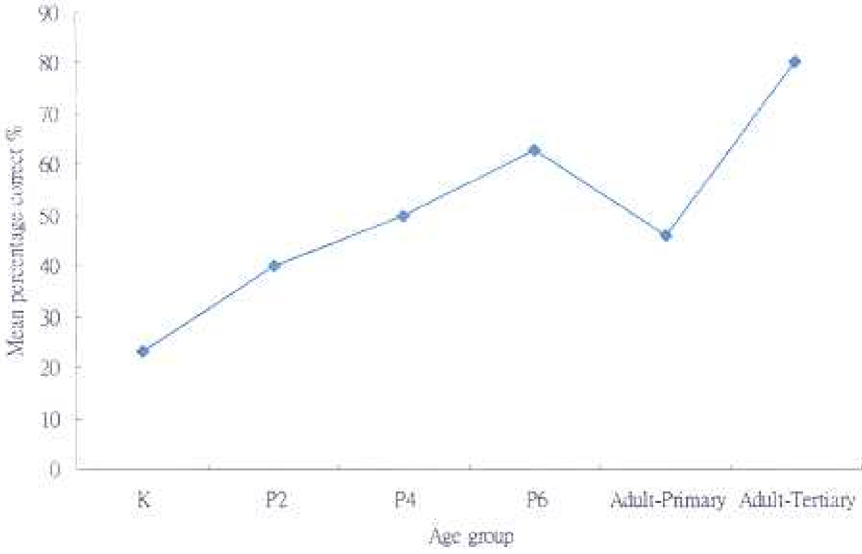

Figure 1. Mean percentage correct of the seven tasks in different age groups.

Primary 6 and 4 children performed significantly better than the kindergarten children (Tukey (HSD) test; p < .000 and p<.01), but the differences between Primary 6 and 4 was not significant. No significant difference was found between children in kindergarten and Primary 2, nor between children in Primary 2 and Primary 4. Tertiary-educated adult performed significantly better than all the age groups (p< .01), except for the Primary 6 children. No significant difference was found between the primary-educated adult and all the children groups.

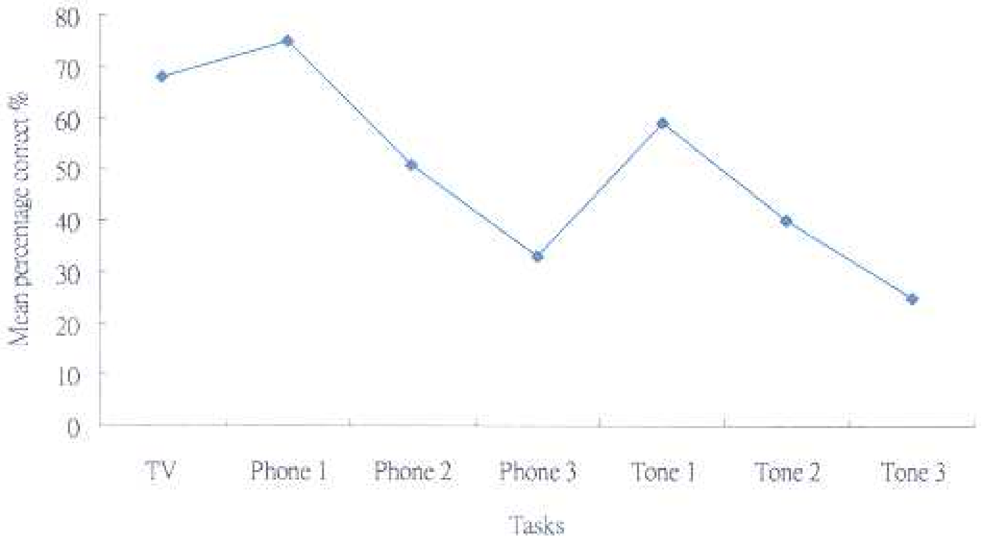

Figure 2. Mean percentage correct for all the listeners in the seven tasks.

Figure 2 shows the mean percentage correct of the listeners in the seven tasks. Differences were found between the three tasks in both Phone and Tone set. Listeners' performance was significantly better on the Phone 1 task (i.e. same initial consonant, varying vowel and final consonant) than on the Phone 2 task (i.e. same final, varying vowel and initial consonant) ($p<.001$). The performance was also significantly better on the Phone 2 task than on the Phone 3 task (i.e. varying both initial and final consonants) ($p<.001$). For the Tone set, a similar pattern was observed, such that, listeners performed significantly better in the Tone 1 task (i.e. varying vowel, same initial and final consonant) than in the Tone 2 task (i.e. varying initial, same vowel and final consonant) ($p>.001$); and better performance in the Tone 2 than in the Tone 3 task (i.e. varying initial and vowel, same final consonant) ($p<.001$). The TV task (i.e. varying the tone, initial consonant and vowel) showed a better performance than most of the Phone and Tone tasks ($p<.001$) except for the Phone 1 and Tone 1 tasks. Furthermore, performance in Phone 1 was significantly better than all the Tone tasks ($p<.01$).

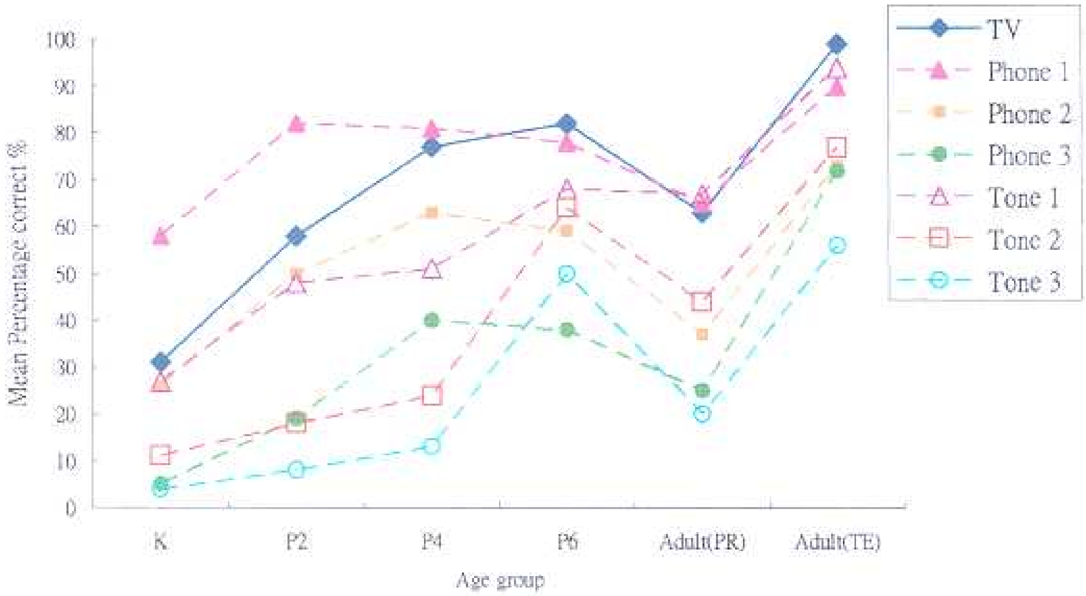

Figure 3. Mean percentage correct in the seven tasks for the listeners in different age groups.

As shown in Figure 3, children in kindergarten, Primary 2 and 4 performed better in the Phone 1 task than in the TV task. But this trend changed from Primary 4 onwards, when performance in the TV and in the Phone 1 tasks did not differ.

The result showed that, although overall better performance occurred in the

Phone 1 than in the Phone 2 task, no significant difference was found in all the age groups except that in kindergarten children ($p<.05$). Also, no significant difference was found in all the age groups between the Phone 2 and the Phone 3 tasks. However, significant difference was found between the Phone 1 and the Phone 3 tasks for all the children groups ($p<.01$). In the tone awareness tasks, no significant difference was found between the Tone 1 and the Tone 2 tasks for all the age groups except Primary 2 children ($p<.05$). A similar developmental trend was observed between the Tone 2 and the Tone 3 tasks; although score in the Tone 2 task was higher than that in the Tone 3 task along the trend, no significant difference was found. Children in Primary 2 and Primary 4, adults in primary-educated level performed significant better in the Tone 1 task than in the Tone 3 task ($p<.01$). As shown in Figure 3, performance in both the Tone 2 and the Tone 3 tasks improved gradually from kindergarten to Primary 4 children; however, a more saliently improvement was shown in the Tone 2 ($p<.002$) and in the Tone 3 tasks ($p<.003$) from Primary 4 to Primary 6 children. For the tertiary-educated and primary-educated adults, a significant difference was only found in the Phone 3 task ($p<.01$).

Reading ability and task performance:

The relationship between the task and the reading ability was investigated by Pearson's correlation coefficient (r). No relationships were found between the reading score and the TV task ($r = -.1404$ and $p<.05$), the Phone 1 task ($r = .2830$ and $p<.05$), the Phone 2 task ($r = .0459$ and $p<.05$), the Phone 3 task ($r = -.0986$, $p<.05$), the Tone 1 task ($r = -.0365$, $p<.05$), the Tone 2 task ($r = -.2640$, $p<.05$) and the Tone 3 task ($r = -.2797$, $p<.05$).

Discussion

The results generally support the prediction that Cantonese children have a better performance in phonological awareness tasks (Phone task) than in tone awareness tasks (Tone task) as significant differences were found in kindergarten, Primary 2 and Primary 4 children between these two tasks. Performance did improve in both tasks as age increased. The overall performance of tertiary-educated adults was significantly better than that of primary-educated adults for all seven tasks ($p<.01$).

Development of phonological and tone awareness

The results show that the phonological and tone awareness generally increased from kindergarten children to adults. Listeners performed generally better in the Phone tasks than in the Tone tasks. Although scores in both Phone and Tone tasks increased across ages in children, the trend in the Tone tasks was flatter than in the Phone task from kindergarten to Primary 4 children. This implies that the development of tone awareness is generally slower than that of the phone awareness during this period. This result is in agreement with findings that, although children could perform tasks in rhyme or tone alone detection at seven years old, they still have a better performance in rhyme alone detection than in tone alone detection (Ho & Bryant, 1997). Performance in the Tone tasks increased sharply from Primary 4 to Primary 6 and from Primary 6 to tertiary-educated adults. The result is consistent with the findings that, at about ten years of age, children have performance comparable to adults in tone perception tasks (Ching, 1984). Although the general performance in the Tone tasks was similar to the Phone tasks from Primary 6 to tertiary-educated adults, the TV task still showed a better performance other than the Tone tasks. This indicates that provision of phonemic information would facilitate the performance in the odd-one-out task than when only tone information is provided.

Education level

The results show that, overall, tertiary-educated adults performed significantly better than the primary-educated adults in all seven tasks, and that both groups shared the same pattern of performance among the seven tasks in the experiment. This finding implies that education plays a role in the development of phonological and tone awareness. According to Read et al (1986), phonemic segmentation would not develop in Chinese adults without the knowledge of alphabetic reading. Therefore, tertiary-educated adults should know alphabetic reading well and should be better than the primary-educated adults in alphabetic reading. Although there is a alphabetic transcription system in assisting people in reading Chinese, Primary school teachers in Hong Kong just teach children to read Chinese in a whole-word-approach and children only remember the pronunciation through rote memory (Ho & Bryant, 1997b). Pupils seldom learn the alphabetic transcription system for reading Chinese in Primary schools. Therefore, the only way for the children and adults to learn alphabetic reading may be through learning to read English. Although both adult groups have the knowledge in reading English, tertiary-educated adults have a longer duration and greater exposure in reading English than their primary-educated peers. Therefore, better performance was shown by the tertiary-educated adults in both phonological and tone awareness tasks. Besides English reading, most of the tertiary-educated adults also have the knowledge in speaking and reading the pinyin in Mandarin. Pinyin is a phonemic representation system used to help people reading Chinese characters. Knowledge of pinyin was found to correlate with tone awareness and phonological skills in a recent study of native Mandarin-speakers (Siok & Fletcher, 2001). Therefore, the pinyin system learned by the tertiary-educated adults may also play a role in performing the phonological and tone awareness tasks. However, their ability in reading Mandarin pinyin was not examined in this study. So, no conclusion would be made whether learning Mandarin pinyin would also facilitate the performance in the phonological or tone awareness tasks for Cantonese adults.

Although the result shows that education plays a role in the development of phonological and tone awareness, no significant difference was found between tertiary-educated adults and Primary 6 children in the performance of all tasks. This result implies that there might be other factors affect the performance of the listeners besides the education level. Alternatively, it is possible that the low sensitivity of the statistical tests to the fact that fewer subjects participated in the group of tertiary-educated adult was responsible for the failure to find a difference.

Performance in different tasks

In general, children had a better performance in the Phone 1 than in the Phone 3 task, and in the Tone 1 than in the Tone 3 task. This result may be due to the different phonemic structures in the odd-one-out in each task. According to Ho and Bryant (1997a), children at five years old were able to detect rhymes alone. In their task, two of the stimuli used shared the same rhyme with different onset, and the odd-one-out did not share any phonemes with them (e.g. /bing1/, /tsoeng1/, /sing1/). In the present study, in both the Phone 1 (e.g. /buam0/, /buaŋ0/, /beːn0/) and the Phone 3 tasks (e.g. /rɔːŋ0/, /tçʰɔːn0/, /lɑːm0/), the rhyme differed in the vowel in the odd item and the similar items just shared the same vowel in the rhyme. So it is expected that children would have a similar performance in these two tasks. However, children did have a better performance in the Phone 1 than in the Phone 3 task. The main difference between the stimuli in the Phone 1 and the Phone 3 task was in the onset part. The three stimuli in the Phone 1 task shared the same onset while those in the Phone 3 task did not. Children might find it difficult to perceive the stimuli in the Phone 3 task as the rhyme-pair, the difference in onset among the three items made it more difficult to detect the odd item. In general, better performance was observed in the Phone 2 task than in the Phone 3 task. The fact that the rhyme was the same in two of the stimuli in the Phone 2 task (e.g. /laːŋ3/, /naːŋ3/, /rɔːŋ3/) would help listeners to match the rhyme-pair and locate the odd-one-one more easily. But the similar-pair in Phone 3 task just shared the same vowel, it would increase the difficulty to locate the odd-one-out in the task. In a study concerning the errors made in short-term memory and the linguistic structure of the syllables found that onset and rhyme units are important in the short-term memory (Treiman and Danis, 1988). Subjects in Treiman and Danis's study were required to recall the six syllables they have heard and their responses were recorded. The result showed that most of the units they retained in the recalled syllables were either the onset or the rhyme of the syllables. Although our short-term memory would basically memorize the perceived syllable as onset and rhyme, listeners might still find it easier to spot the differences in rhyme than in onset. It is because vowels are likely to be easier to perceive because of longer duration than consonants, and because vowels are sonorant sounds and contain higher energy than consonants (Uhry and Ehri, 1999).

For the Tone task, tone changes were the main concern. And the listeners showed a different performance among the tone tasks. Significant better performance was found between the Tone 1 and Tone 3 tasks in Primary 2, Primary 4 and primary-educated adults. The differences in phonemic structures might also play a role in affecting the listeners' performance. In the Tone 1 task, three stimuli shared the same onset but the rhyme was different (e.g. /juan0/, /ja:n0/, /jɔ:n3/). In the Tone 3 task, all the three stimuli differed in both onset and rhyme (e.g. /tɔ:n2/, /sa:n2/, /jɔ:n0/), listeners might be confused by the differences in phonemic structures among the stimuli. Therefore, that they might not be able to match the two similar stimuli and locate the odd-one-out, leading to poorer performance in the Tone 3 than in the Tone 1 task.

Comparison between Thai, Australian and Cantonese listeners

A similar experiment was conducted with both Thai and Australian participants. Similar result was found across different ages and tasks (Burnham et al, 2003). Thai adults (both primary and tertiary-educated) performed generally better than children, and tertiary-educated adults did better than their primary-educated peers. Performance in the Phone task was generally better than the Tone task in all age groups. However, greater improvement was found in the Tone task between Primary 2 and Primary 4 rather than between Primary 4 and Primary 6. The performance of primary-educated adults in the Phone task was comparable with that of the tertiary-educated adults; they only performed poorly than their tertiary-educated peers in the Tone task. The differences in tone awareness task in Thai adults were most probably due to the education level, as suggested by the authors. In Thailand, the tertiary-educated adults obtained nearly 100% correct in the TV, Phone and Tone tasks. However, Cantonese tertiary-educated adults just obtained 90% correct in the TV task, 70-80% in both the Phone and Tone tasks. The differences between Thai and Cantonese adults might be probably due to the familiarity of the Thai language of Thai adults. The result implies that people with experience in their native tonal language may not perceive equally well for the other tonal language. Similar experiment in Cantonese could be carried out in Thai in order to compare the effect in perceiving native and non-native stimuli.

For the Australian listeners, similar performance was found in the TV and Phone tasks. Adults performed generally better than all the children groups and the performance improved according to age. And a sharp improvement was observed in the Phone task from kindergarten to Primary 2 children. This finding implies that learning to read an alphabetic script does help children to improve their phonological awareness. However, Australian listeners did generally poorer than Thai and Cantonese listeners in the tone awareness task. They showed a limited increment in the Tone tasks across ages. Only 40% and 25% correct were obtained by Primary 6 children and tertiary-educated adults in the Tone tasks. By contrast, Thai children in Primary 6 and adults received tertiary-education were able to obtain 45% and 100% correct in the Tone task. Although Cantonese tertiary-educated adult obtained a lower percentage correct than that of Thai, they still obtained 75% correct in the Tone task. Cantonese Primary 6 children also obtained a higher score (i.e. 60%) in the Tone task than that of Australian peers. This implies that people with experience in tonal language have an advantage in perceiving tonal stimuli in a non-native tonal language than those without such experience.

Suggestions for further research

Firstly, numbers in two groups of adults were not equal to that of children. More adults should be recruited, as unequal numbers in each group would lead to a lower sensitivity of statistical tests. Secondly, the ability of reading pinyin in Mandarin of the listeners was not examined as learning pinyin system in Mandarin might also play a role in performing the phone and tone awareness tasks. Thirdly, as only a reading screening was done for primary school children in this study, any effects come from reading ability was not clear. Comparison could be made by recruiting a group of children with good reading ability and the other group with poor reading ability as defined by the reading test.

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